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Lubrication

A Technical Publication Devoted to the Selection and Use of Lubricants

THIS ISSUE

Modern Glass Making Machinery and Its Lubrication

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Modern Glass Making Machinery And Its Lubrication

ALTHOUGH the art of glass making has been known to the world since the remote ages, its advancement to a stage of scientific achievement can be dated over only the past 50 years. During this comparatively recent development modern glass manufacture has made remarkable strides till today it is well classified as one of the prime factors of civilized industry. Invention of mechanical equipment such as the bottle blowing machine, the plate glass casting table, and the variety of specialty devices such as presses and moulds, have elevated glass making from a crude trade to a veritable science. In fact today, were we to be deprived of our knowledge of the processes involved, it would mean the crippling of the industries of the world, the throttling of science, chemistry and medicine, and would throw our home life back into a state of discomfort typical of the middle ages.

It is only natural, with such a development, that lubrication should have come to play an important part in the glass industry. A specific instance is frequently encountered in the operation of the vacuum gathering type of glass bottle machine in event of using a lubricant of high residual carbon content. In such a case, especially if the receiver attached to the vacuum pump cylinders is not properly drained, an accumulation of glass, burned oil and carbon is apt to be drawn through the header on the bottle machine, over into the receiver and thence into the vacuum pump cylinder.

The mechanical manufacture of glass in general can be classified under three general headings, i. e.: Plate glass making, where the molten glass is directly poured and cast on the casting table; Bottle making, wherein the principle of blowing (chiefly by use of compressed air) still is in use; Window glass making, wherein the glass is either blown mechanically into long cylinders, to be subsequently cut and flattened, or directly drawn from the furnace in great sheets.

Constituents of Modern Glass

Before dealing specifically with the above processes a brief description of the manner in which glass is compounded for melting, and the constituents that go to make up the charge, will be of interest. In modern glass making these ingredients are generally silica (sand), soda-ash (or potash), lime, borax, and lead (or some other metal). Sand constitutes from 50% to 75% of this mixture. Soda ash (sodium carbonate) forms the flux; it is used instead of potash when low melting point and economy are desired. Potash, however, is preferable where glass of high brilliancy is to be made. Lime (or calcium carbonate) serves chiefly as a hardening agent though it also facilitates melting and refining of the batch. Borax is

used to produce low expansion, and nitre is often used on account of its high oxygen content.

It is necessary to have a metallic component in the glass as a general rule, to increase the brilliancy and render the final product heat resisting. In this respect lead in the form of litharge or red lead is chiefly used. However, to manufacture a glass of special qualifications frequently lead is replaced by zinc, aluminum, arsenic, tin, barium, antimony or other rarer elements.

Mixing

In modern practice it is customary to store the above ingredients in overhead bins, from which they can be fed, as desired, in measured amounts, into a mechanical mixer generally mounted on an electrically driven car. After thorough mixing the batch is emptied into a chute, to travel by gravity or some form of conveyor directly to the filling end of the furnace. It is customary to add to each batch a certain amount of broken (scrap) glass known as "cullet", which has been passed through grinders before mixing.

Melting

In the mechanical glass plant where there is large production melting is carried out either in a pot or tank of from 50 to 500 tons capacity, at a temperature varying usually from 2400 to 3000° F. The practice of melting in fire clay pots, except in the plate glass plant, has been practically discarded due to excessive cost, waste of fuel, and time necessary to bring the batch to suitable fluidity. Using the tank furnace a continuous supply of glass is available for instant use as desired. Present-day practice is to use either an intermittent or continuous tank as conditions may call for. The former, as its name implies, is used for melting a definite batch, or batches, and does not usually operate continuously over more than a working day. In the continuous tank, however, the batch is charged at regular intervals to make up for molten glass being withdrawn. Therefore it is built with a charging and a working end. In the former, actual melting occurs, the charge flowing therefrom through a restricted passage, known as the "throat", into the working end where refining takes place, and from which the molten glass is drawn as required.

In bottle making, when the vacuum gathering type of machine is used, the working end of the furnace frequently comprises a revolving tank, driven by motor through suitable reduction gearing. The purpose of this rotary motion is to constantly present a fresh surface of molten glass to the suction moulds and at the same time facilitate skimming.

In the manufacture of plate glass it is still considered most efficient practice to melt the batches in fire-clay pots of about 1-ton capacity each. Primarily, this is due to the necessity of pouring the contents directly onto the casting table, and the feasibility with which such pots can be handled by a charging crane or trolley.

The manufacture of pots used for plate glass and other melts is a tedious process. In general, time and care are essential to forestall the possibility of detrimental ingredients remaining in the clay, otherwise these might be fused out and probably cause the ruination of both pot and glass. Clay for such pots is therefore carefully selected, and weathered for sufficient time to cause preliminary disintegration. It is then mixed with other grades of raw and burned clay, and also water. Thus the possibility of shrinking or cracking later on is decreased. This mixture must then be kneaded and allowed to age for a lengthy period. The final treatment it receives is treading, to bring it to as perfect plasticity as possible; preferably this is carried out by the workers' bare feet. The clay is then ready for moulding, after which the pots should be allowed to season for from two months to a year before usage. The life of such a pot, even after the most careful preparation, is usually not longer than a month, and from 25 to 75 melts can ordinarily be made therein.

The unused pot is set in the furnace and brought up to a required pre-determined temperature before being charged; such preheating usually takes several days. The charging process must be repeated about three times before the pot contains its proper amount of molten glass, due to the melting down of the raw ingredients and consequent reduction in volume. Further refining must then take place to insure the complete removal of impurities which are skimmed off before the charge is poured.

Casting of Plate Glass

Having thus rendered the charge fit for plate glass casting, the pot is then lifted from the furnace by an overhead crane and conveyed to the casting table upon which the molten glass is poured. To obtain a plate of any desired thickness it is customary to build up the sides of the casting table with removable metal strips or battens of the proper height. The length of the plate is regulated by means of an adjustable batten on the furthermost end of the table.

Courtesy of Hires-Turner Glass Company

Fig. 1.—Pouring molten glass from the melting pot onto the plate glass casting table. Here the plastic sheet is ironed out by the metal roller at the left. This is the first stage in the process of making plate glass.

Having poured the plate, the next step is to roll or iron it out into a slab of uniform thickness (while still in plastic condition) by means of a heavy mechanical roller. After ironing, the plate is transferred by rollers to a multi-chambered lehr (or annealing oven) where it is first re-heated and then tempered to prevent subsequent damage from cracking, curling or shriveling, by having its temperature reduced to normal in gradual stages.

When cooled to the required degree the plate then passes to the cutter, whose duty is to square it to the desired size and remove rough edges. In certain plants the plates may be then stacked on edge to await grinding and polishing, being handled by hydraulic mechanism and overhead cranes fitted with special grip devices.

The final process is grinding and polishing, which is usually performed on a special revolving grinding table. Here the rough, opaque surface of the glass is removed and the plate rendered smooth and transparent by means of one or more set of revolving iron runners (carried by a framework above the table) in conjunction with sand and emery. In this procedure the thickness of the plate is reduced about 50%, being worked down first on one side and then on the other. Prior to actual treatment, however, the plate must be suitably fastened to the table by being firmly imbedded in a plaster of paris or cement setting, and pegged down with wooden blocks, to give the utmost security. To protect the outer edges of the plate from damage, smaller plates usually surround it in the same setting.

Sand is usually the preliminary grinding agent, it being fed onto the glass and worked in by the runners in conjunction with a stream of water. Emery powder in successively finer grades follows the sand, after which the plate receives careful inspection to detect flaws of any nature. Frequently, if these are not excessive, the plate can be saved by proper cutting away of the objectionable parts, but if this is not possible the entire plate must be discarded, in which event it is recharged as cullet. After this inspection the plate is removed to the finishing machine and subjected to final polishing,

the customary abrasive being a mixture of rouge and water, which is worked over the surface by means of felt runners. To obtain perfect transparency both sides of the plate must be similarly ground and polished. The finished plate is then ready for the market, unless bevelling is desired. In this event the process of grinding away the edges is much the same as the preliminary grinding though it is carried out in several successive steps by devices known as the roughing mill and polishing wheel, the final finish being attained by means of rouge and felt buffers.

Manufacture of Glass Bottles

The manufacture of glass bottles today has been developed almost entirely into a mechanical process, wherein blowing is done by compressed air, on some form of specially designed bottle making machine. Hand blowing is rapidly becoming obsolete due to the ability of such machinery to speed up production. When we consider that the glass bottle industry produces from 40% to 50% of the total glass of the United States, the necessity of a machine to blow from 30 to 60 bottles per minute can be appreciated. In addition, the machine made bottle will usually be better adapted for automatic filling due to being of more uniform finish, standard weight and capacity.

According to the design of the machine, bottle making is classed either as semi-automatic or automatic. Essentially the difference occurs in the manner of filling the moulds with molten glass, and the transference of the bottle "blanks" from the preliminary to the finishing or blowing moulds. The semi-automatic design requires manual labor for these two steps. The automatic machine, however, eliminates the handworker and simply calls for general supervision and periodic attention to lubrication and other necessary operating details.

As generally constructed the dual-table semi-automatic and automatic machine consists essentially of two circular, geared tables, each carrying in symmetrical arrangement the same number of split moulds, which open and close automatically at suitable intervals with the rotation of the tables. The moulds on the first table receive the molten glass or bottle "blanks", being either charged by hand or mechanically from the melting furnace. "Blanks" are usually modelled bottom-upwards. Upon rotation of the table through an arc the degree of which depends on the number of moulds, a pneumatic plunger seals the top of the mould in question, and a piston similarly driven ascends through the base of the mould, to form the neck of the bottle by its pressure. The table then revolves through another similar arc, and the embryo bottle is given a preliminary blow with compressed air. The next rotation causes the mould in question to open automatically, the blank being removed, inverted, and inserted in the corresponding finishing mould on the companion table. This operation may be automatic or carried out by hand, as explained above. Both tables then revolve through another similar arc, the respective moulds on each closing automatically. Following this, the bottle is blown to final shape by compressed air, chilled somewhat by an air blast to set the glass, and then passed to the lehr for annealing.

Another type of automatic bottle machine consists of a single revolving table, carrying the blank moulds on fixed arms, the finishing moulds being contained in pivotted arms symmetrically located below. As the machine rotates the "blank" moulds pass directly over the molten glass in the furnace, and by means of a partial vacuum which is applied to the moulds, a charge of glass is drawn up therein. After the "blank" is gathered a pivotted cutter trims it off even with the bottom of the mould and a foot piece (or plunger) rises to form a preliminary cavity after which the bottle is given a partial blow with compressed air. A shoe then slides over across the top of the "blank" to give it the proper surface. The blank mould then opens, to enable the red hot bottle to be seized by the finishing mould which is automatically brought up into position by its pivotted carrier. Final blowing is then carried out while the finishing mould presses the exterior of the bottle into a uniform surface. The bottle is then automatically released by the opening of the mould, to drop into a hopper for transference to the lehr. At frequent intervals the moulds must be swabbed to prevent sticking of the bottles. When bottles of smaller sizes are to be blown on this machine the moulds may be

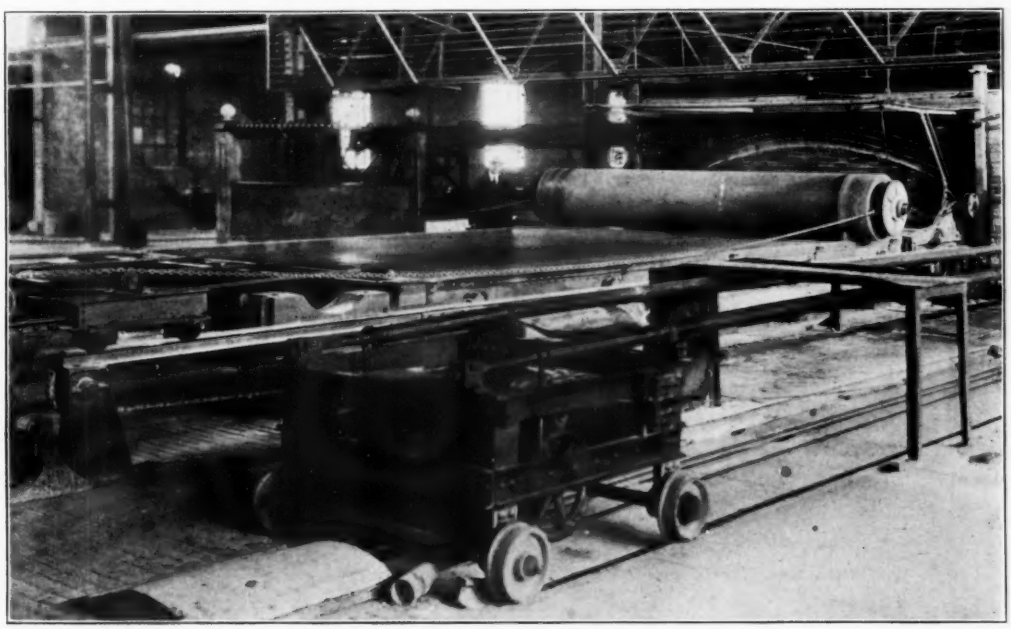
constructed to handle two or more at a time.

With such a machine an air pump and a vacuum pump are necessary equipment. The requisite air pressure for blowing is in the neighborhood of 30 lbs., while a considerable vacuum is essential for proper gathering of the charge.

Window Glass

In the making of window glass the same transition from hand blowing to mechanical methods has taken place as in the glass bottle manufacture, with the result that today approximately 60% of this product in the U. S. is machine made. Demand for greater production has to a large extent led to this development, though the welfare of the worker has been the basis of much study and investigation. In fact, in the hand plant it is infrequent for an employe to work more than seven months out of a year due to the excessive heat encountered.

Today there are two basic processes in use for the production of machine-made window glass. In the first, the principles of hand blowing are still retained, the glass being gathered by a mushroom-shaped cup, known as the "bait," attached to a long tube similar to the hand blow pipe. This pipe is carried by an electric hoist guided so as to be capable of vertical motion only. To gather a charge the "bait" is lowered into the molten glass receptacle which may be either an individual hot pot filled intermittently from the furnace with sufficient glass for one draw or a projecting container into which glass can flow directly from the melting tank. The bait then is drawn out of the bath and raised steadily (at a carefully regulated speed) pulling after it a lengthening semi-plastic cylinder of glass. Simultaneously a uniform current of compressed air is blown through the pipe carrying the bait and into the cylinder to maintain it in expanded condition and neutralize atmospheric pressure from without. With such equipment it is possible to blow cylinders of about 30 inches in diameter and up to 50 feet in length, or about five or six times as long as by hand blowing. The thickness of the cylinder is controlled by the speed at which the bait is raised.



Courtesy of Compressed Air Magazine Co.

Fig. 2.—Detailed view of the casting table and accessory equipment in the plate glass plant.

When this cylinder of glass has been drawn out to the desired length the base is severed from the molten mass in the hot pot and the elevator lifting mechanism and hoist manipulated to swing it clear, lower it into horizontal position, and onto a rack fitted with semi-circular supporting brackets. The bait is then

severed from the finished glass cylinder by encircling it with an electrically heated wire, and the tube cut in sections as desired in like manner. These sections are then split longitudinally, or if desired, into two semi-circular halves, and transferred to the flattening oven where each is re-heated sufficiently to enable it to be ironed flat. The final step is transference into the lehr where annealing is carried out. The length of time a sheet requires for such treatment will depend on its thickness. From half an hour to an hour is the usual period, after which the glass passes to the cutters for reduction to sizes as desired.

Another type of equipment does away with the blowing process and draws a continuous sheet of glass directly from the pot and onto a flattening table. To start a sheet, it is customary to lower an iron bar or "bait" about 5 feet long, horizontally into the molten glass. This, with its gather of plastic product, is then raised vertically to a height of about 2½ feet to enable the glass strip to be drawn over an adjacent roller. The bait is then pulled along horizontally to spread the semi-solid sheet out after it on the flattening table, to the desired length, or a maximum of 200 feet. After this the bait is severed from the sheet and the latter passed to the lehr by mechanical rollers. Emerging from the lehr, it passes to the cutting department for final treatment before marketing. Thickness of the sheet is controlled by the speed at which the strip is drawn out onto the flattening table.

Pressing Glassware

In the manufacture of jars, wide mouth bottles and block mould ware, such as tumblers and other table utensils, modern practice has to a great extent substituted the principle of pressing (or the forming by internal and external pressure) for that of blowing or casting. The pressing action is performed on a specially constructed machine, the heated glass, after charging, being forced to the shape of the mould by means of a pneumatically operated piston. This operates generally in connection with a direct acting press or a toggle mechanism, the moulds being carried on a revolving table. It is claimed that the toggle device enables a better distribution of load, and is more adaptable to better grades of pressed ware.

Glass Specialty Manufacture

In the manufacture of certain specialties the process involves a combination of blowing and pressing in so-called paste-moulds. This method is particularly adaptable to seamless glassware such as tumblers, lamp chimneys, lantern globes and electric light bulbs. In general the molten glass is gathered either automatically or by hand, on a blow pipe, placed in the mould and blown by compressed air to conform to the shape of the latter while it is rotated. This retains the natural polish on the outer surface and eliminates the seams otherwise caused by the joints in the mould. Subsequently annealing is carried out in a simple form of lehr.

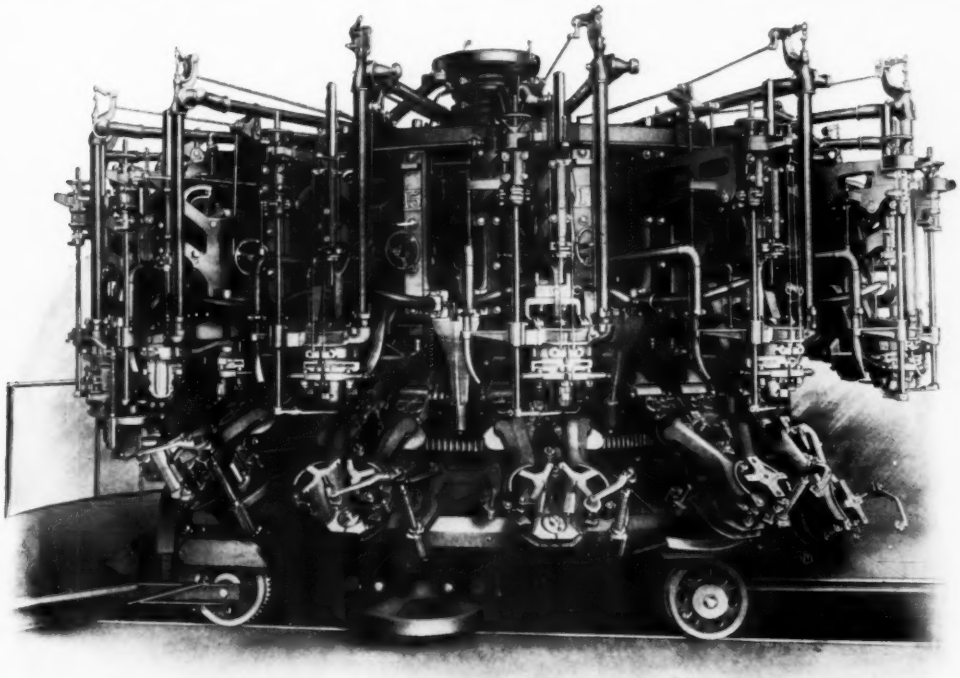
When specialties involve shapes other than circular, which would not permit of rotation, casting and pressing are generally resorted to. Such designs include automobile headlight glasses, light-house lenses, intricate vases, and a multitude of other glassware.

Relation of the Lehr

The part played by the lehr in the glass industry is quite as important as the preliminary formation of the product. Essentially lehr operation involves a combination of time, speed and temperature in order to subject the glass to an annealing or gradual cooling treatment. Thereby the glass is insured against too rapid cooling of the surfaces and resultant internal stresses, which would probably cause curling, shrinking, cracking or complete fracture later on. In other words the entire body of the glass must be uniformly cooled throughout its mass.

In construction the lehr is usually an oven-like brick and steel plate housing of from 50 to 300 feet in length, according to material handled, and of a height and width to conform to the type of glassware produced. Extending longitudinally within, is installed a form of conveyor such that the grade of product can be suitably carried thereon. This is electrically driven from without through an arrangement of reduction gearing. Cam mechanism or an automatic rack and pinion device is installed where travel of the ware is desired to be periodic instead of continuous. In the bottle plant the conveyor is usually an intermittently traveling rack, carrying suitable metallic sections with pockets into which the finished bottles are automatically deposited upon leaving the bottle

machine. Each section carries about 24 bottles, and travel is set at a rate of approximately 20 feet per hour, though this speed will largely depend on the size of the bottles. On the discharge end of the lehr these sections are automatically returned to the charging end by a similar conveyor rack. Another design builds the rack with fixed plates or pans for conveying the bottles. In this machine the mechanism is similar to an endless chain in its operation.



Courtesy of The Owens Bottle Co.

Fig. 3.—15-Arm Automatic Bottle Blowing Machine. This is a single table vacuum type of machine, involving no manual labor whatsoever except general attention to the moulds and lubricating system which is generally force feed.

In usual practice the lehr is heated at the charging end to a temperature of from 800° to 1200°F., dependent on the size and type of glass treated. Oil or gas is the usual fuel. Heat is controlled by means of a muffle and waste heat flue arrangement whereby any temperature can be secured and maintained as desired, and sulphurous fumes, which would have a discoloring effect on the glass, are kept from possible contact therewith.

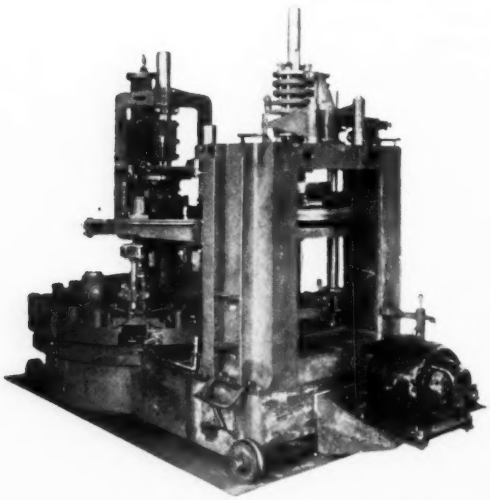
LUBRICATION

Plate Glass Machinery

Probably the most prevalent lubrication problem in the manufacture of plate glass occurs on polishing machine step bearings. Owing to the necessity for fine adjustment, continuous operation, and the great weight carried (i.e., approximately 60 tons), the lubricant used must be of sufficient body to insure an adequate film of oil of suitable oiliness to properly protect the bearing surfaces. The frequent installation of patent step bearings reduces the load on the oil film to a certain extent, but not enough to ever warrant the use of any but the highest grade of lubricant For this service the latter should be a pure mineral product of the nature of cylinder oil, having a viscosity of about 160″ Saybolt at 210° F. It is best practice to run such step bearings in a bath of lubricant.

For the upper or guide bearings of the polishing machine a straight engine oil of about 200″ Saybolt viscosity at 100° F. will be suitable. This lubricant is usually applied through a force feed circulating system. The same oil is applicable to the bearings of the driving gear shaft and motor. Lubrication of the main driving

(reduction) gearing should be maintained by means of a pure petroleum lubricant of sufficient body to adhere tenaciously to the



Courtesy of William J. Miller

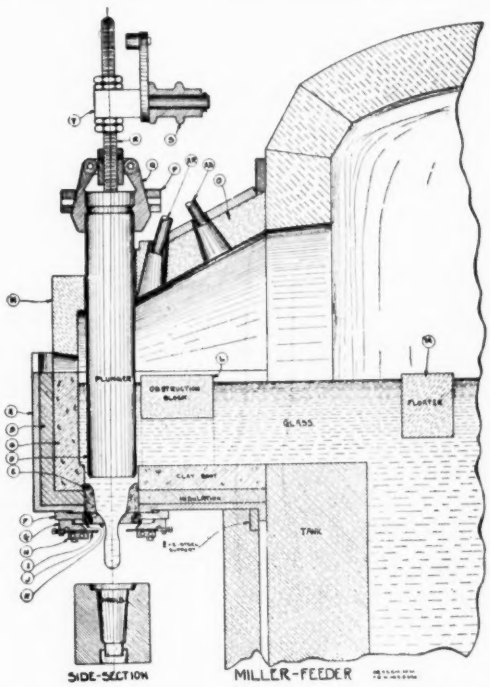
Fig. 4.—Type of machine used for the manufacture of press glassware such as wide mouth bottles and jars. This device is automatically lubricated by force feed from a reservoir in the base. The oil at no time becomes hot enough to burn, 150° F. being about the maximum temperature.

teeth. If, however, the lubricant is too heavy and not of the proper consistency it is apt to ball up and be thrown off by centrifugal force. A gear lubricant of 1000″ Saybolt viscosity at 210° F. will be admirable for this purpose.

The bevel gear and pinion which serve to rotate the polishing machine can be either lubricated with the above gear lubricant, if open lubrication is desired; or, a lighter product of pure petroleum nature can be used (such as mineral cylinder oil) if the equipment is designed for automatic circulation of the lubricant. In this case the viscosity should be about 140″ to 150″ Saybolt at 210° F.

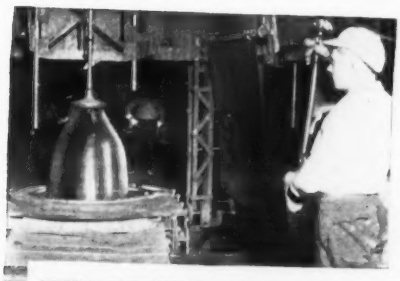
Lubrication of the grinding machine whereon the plate glass receives its preliminary treatment is similar to the lubrication of the polishing machine in most respects. On this equipment the grinding runners, which are usually of iron, are set rigidly in a circular device which is designed to rotate automatically by virtue of contact with the revolving grinding table. Two of such sets of runners are usually installed per table. The vertical guide bearings for the spindles of these runner-carrying devices require careful lubrication in order to insure against possible shut-down of a table. Usual construction calls for a plain guide bearing for the top of the spindle, with a cone bearing below. This latter generally operates in a bath of lubricant. The top bearing, however, may be hand oiled, or served by a wick feed or circulating system. On such service a medium engine oil of about 200″ Saybolt viscosity at 100° F. is suitable.

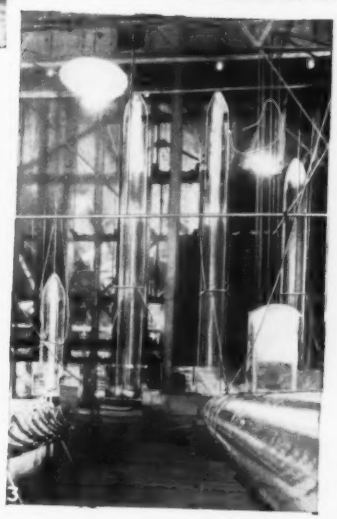
Other equipment in the plate glass plant requiring lubrication comprises the traveling mechanism on the lehrs, ironing roller mechanism, pot charging trolleys, and various overhead cranes for pouring, handling of the plates after casting, or for other purposes. In general such lubrication involves no specific problems and it can be broadly classed under two distinct headings, i.e., lubrication of (1) gears and (2) bearings. For gearing the gear lubricant specified for the polishing machine will be suitable, though in many plants the custom is to run gearing practically submerged in a bath of lighter lubricant similar to cylinder oil. For general bearing lubrication a good grade of engine oil of a viscosity from 200″ to 300″ Saybolt at 100° F. will give admirable results.

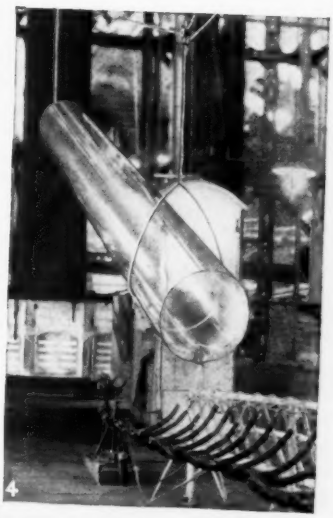


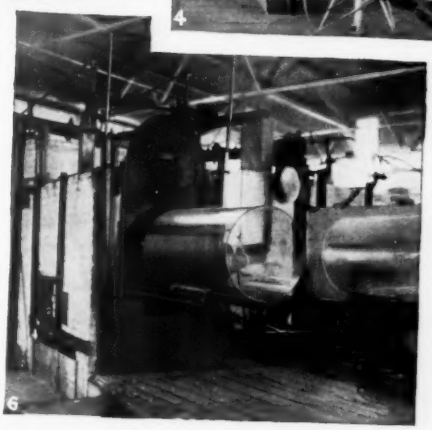
Courtesy of William J. Miller

Fig. 5.—Sectional view of a type of automatic glass feeder, frequently used with pressware equipment. This machine requires from one to three drops of oil for each cut of molten glass, the lubricant being burned on each stroke of the plunger.









Cuts Courtesy of Hires-Turner Glass Company

The Mechanical Blowing of Window Glass

Part 1. Pouring molten glass into the pot prior to blowing a cylinder of window glass.

Part 2. Start of a machine blown cylinder of glass. Note the bait to which the glass adheres. This is drawn upward to produce the cylinder.

Part 3. Glass cylinders in several stages of blowing.

Part 4. Lowering the newly blown cylinder into the horizontal rack for cutting.

Part 5. Cutting the cylinder into sections for ease of handling.

Part 6. Split sections entering the flattening oven.

Bottle Machinery

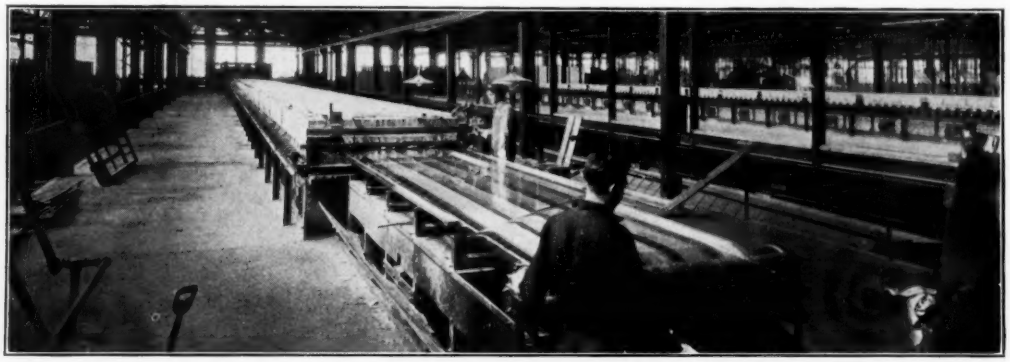
Lubrication of the vacuum type of automatic bottle machine is perhaps the most exacting problem of this nature that confronts the glass engineer. It has been found that on this machine it is most essential that the lubricant show as low a percentage of carbon residue as possible. Otherwise a composition of burned oil and carbon will be developed to be drawn through the headers by the suction effect in gathering the glass, and accumulated in the receiver which is usually located between the bottle machine and the intake side of the vacuum pump. Ultimately a certain amount of this residue will pass into the vacuum pump cylinder, necessitating frequent cleaning of valves, cylinder head, exhaust pipe and receiver. Experience indicates that the most suitable oil for this machine is a relatively light bodied pure mineral product of from 150″ to 200″ Saybolt viscosity at 100° F., and of exceedingly low carbon residue content. In general this oil is applied by a force feed lubricating system, to the entire operating mechanism on the machine. The main spindle of this machine is supported by a step bearing, and customarily operates in a bath of oil. For this purpose a similar highly refined mineral oil of the same viscosity is most suitable. The driving mechanism which is reduction gearing, is generally bath lubricated with a fairly heavy straight mineral gear lubricant of about 1,000″ Saybolt viscosity at 210° F. On the top spindle guide bearing it is customary to use sponge grease or a medium bodied compression grease.

In the dual table bottle machine, gearing should in general be lubricated with a similar gear compound as described above; other operating parts can be well taken care of by using a straight mineral oil of about 200″ Saybolt viscosity. No essential difficulties arise in lubricating such a machine.

Window Glass Machinery

In plants where sheet glass is automatically drawn and blown, lubrication is chiefly confined to mixing equipment, carrying devices, electric motors and auxiliary equipment such as air blowers, compressors and gas producers. The actual glass making equipment involves but one abnormal condition to be met by the lubricant, i.e., excessive heat. On the guide rods of the bait-carrying mechanism it is customary to use a swab of waste saturated with engine oil. Motion is slow, however, and clearances are large, so it is apparent that no decided wear could occur even though such guides were run dry. Lubrication of hoisting, carrying and elevator equipment can be classified as involving (1) gears and (2) bearings. A gear lubricant of about 1000″ Saybolt viscosity at 210° F. will adequately take care of straight gearing, while a lighter compound of similar nature, having a viscosity of about 120–130″ at 210° F. should be used on worm gears. A good mineral engine oil of from 200″ to 300″ Saybolt viscosity at 100° F. will be suitable for all bearings, including the ring or chain oiled type customarily installed on electric motors.

Where window glass is drawn directly from the melting pot and onto the flattening table, lubrication of the drawing machine and rolls is an important question. Due to the high temperature encountered all such bearings and operating mechanism should be lubricated with



Courtesy of The Libbey-Owens Sheet Glass Co.

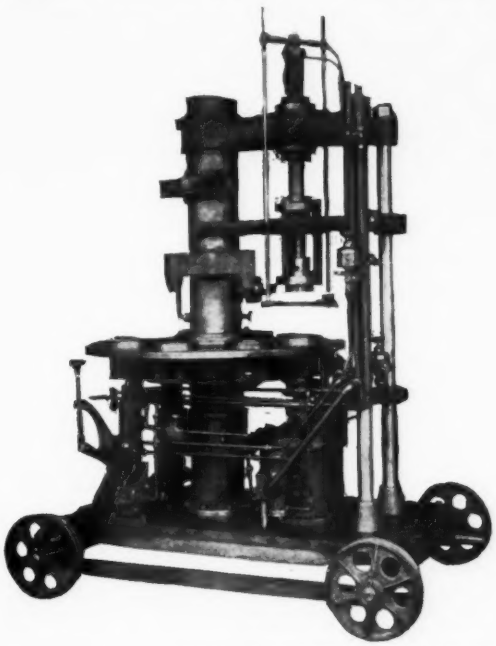
Fig. 12.—Cutting table used in connection with the flat drawn process for making sheet glass.

a high flash point product of pure petroleum nature having a low degree of evaporation. Normally these temperatures will average about 600° F.

For worm driving and bevel gear mechanism a straight mineral product should be used, having a viscosity of from 120″ to 130″ Saybolt at 210° F. Other operating mechanism and bearings can usually be properly served by a good light engine oil of about 200″ Saybolt at 100° F. or sponge grease where compression grease cup lubrication is desired.

Pressing Machinery

Lubrication of glass pressing equipment is in general carried out by automatic means, or the machines are so designed that bath or splash lubrication will be possible. In the wide mouth bottle press the operating gearing usually runs submerged in a bath of oil in the base of the machine. Certain types of these machines in addition are equipped with an oil pump, filter and adjustable sight feed lubricators, and the process of lubrication of other working parts is continuous and automatic.



Courtesy of Miller Machine & Mould Works

Fig. 13.—Type of 8-Mould Automatic Pressing Machine as used for the manufacture of tumblers, jelly glasses, auto lenses, etc. This machine operates by compressed air with a production up to 30 pieces a minute.

For the lubrication of such gearing a straight mineral oil of about 120″ Saybolt viscosity at 210° F. will be suitable. Where automatic lubricating systems are installed a good grade of light engine oil, having a viscosity of 200″ to 300″ Saybolt at 100° F. should be used.

The table carrying the moulds is usually of revolving type, mounted on steel ball bearings. On such service a light bodied compression cup grease or a lubricant of petrolatum nature is most suitable. On the other hand, some operators prefer to flood the raceway for the ball bearings with a fairly heavy grade of engine oil.

In the modern glass press it is customary to lubricate the air cylinders and other pertinent parts with which the air comes in contact, by impregnating this air with lubricant as it enters the machine. To accomplish this an automatic sight feed lubricator is usually installed in the main air supply line. Thus the air stream in its passage through the machine carries the necessary lubricant to serve the valves and cylinders, to cool, clean and lubricate the shear blades, and clean and lubricate the blank moulds. In addition where certain of the rotating mechanism is operated by air, the oil it contains lubricates these parts and prevents to a large extent the accumulation of crushed glass.

Auxiliary Machinery

There is a certain amount of equipment which will normally be common to almost every plant where glass is manufactured by machinery. Under this classification would be included the hoisting, conveying and crushing devices necessary for mixing of the raw ingredients, air compressors and blowers required for furnishing the air for blowing, or operating certain of the equipment in lieu of steam or electricity, gas producers for the generation of gas for fuel purposes, where adjacent supplies of natural or artificial gas are inadequate, and the lubrication of steam cylinders.

Mixing Equipment

Lubrication of the customary mechanism involved in mixing can in general be regarded from the same viewpoint as the lubrication of window glass blowing equipment, i.e., as including (1) gears, and (2) bearings. Under normal conditions the same grades of lubricants will be satisfactory as recommended above. On account of the amount of dust usually present,

steps should be taken wherever possible to protect gears and pinions with suitable housings, and bearing oil-ways with waste pads or covers, unless automatic lubrication is possible. In addition such operating mechanisms should be inspected regularly, kept as clean as possible and oiled rather more freely than usual.

Compressors

Inasmuch as compressed air is frequently the medium for operating certain of the glass handling mechanism, the lubrication of air compressors becomes, therefore, an important factor.* When designed for crankcase lubrication, a medium non-emulsifiable oil of about 180″ Saybolt viscosity should be used. Other designs of compressors such as the locomotive type, etc., will simply involve the lubrication of air cylinders usually using a straight pale mineral oil of 200″ Saybolt at 100° F.

Blowers

Lubrication of air blowers is chiefly a matter of oiling bearings. For this service a good engine oil of from 300″ to 500″ Saybolt viscosity at 100° F. will be suitable, whether hand oiling, sight feed oil cups or ring or chain oiling is customary. In crankcase and splash oiling systems the lubricant used for compressors is recommended.

Gas Producers

The lubrication of gas producers, which are necessary adjuncts to many plants, is confined chiefly to the rotating mechanism involving gearing and accessory bearings. The same recommendations hold in this case as given under window glass machinery.

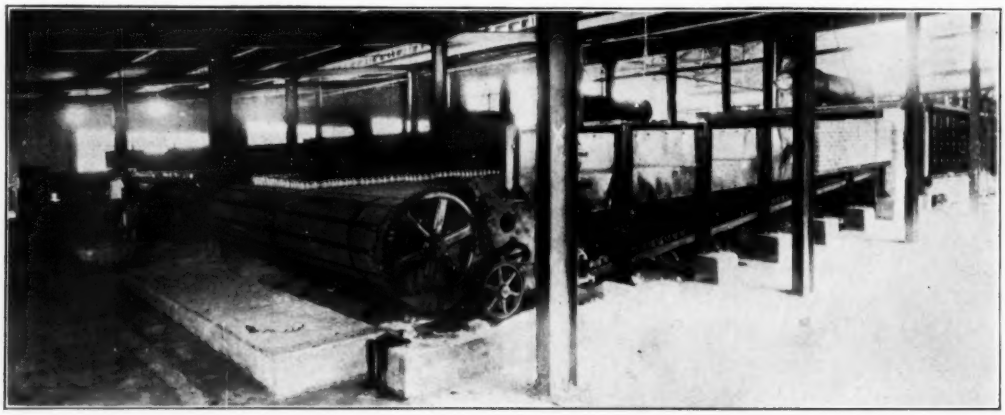
Cylinders:

Steam cylinder lubrication is frequently necessary where steam is the basis for driving any of the above equipment or generating electric power. This topic has been extensively covered in a previous issue of LUBRICATION.*

Conclusion

Owing to the magnitude of the glass making industry, especially in regard to specialties, it has been possible to treat only the manufacture of the more commonly used products in detail. It is in these processes, however, that problems in lubrication will most usually be encountered, and therefore they are of paramount interest to the engineer. In fact the manufacture of glass specialties involves little or no intricate machinery and hand operations still exist more than anywhere else in the industry.

It can be appreciated that due to the usually abnormal conditions under which lubrication must be carried out, the possibility of faults arising in this phase of plant operation is almost always present. Excessive heat, dust and other conditions conducive to breakdowns in the lubricating processes exist so generally in certain parts of every automatic glass producing plant, that the utmost care should always be observed in the original selection of the lubricant, and in its subsequent application.



Courtesy of H. L. Dixon Company

Fig. 14.—Muffle type of lehr for small glassware annealing, such as bottles, tumblers, etc. Details of driving mechanism are clearly shown.

*See Lubrication For December 1921, "External Lubrication of Engine and Compressors".

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TEXACO LUBRICANTS

FOR GLASS-MAKING MACHINERY

A suggestive list of recommendations, taking into account the major processes of manufacture

Plate Glass Machinery:	**Polishing and Grinding Machines:**	
	Step Bearings	TEXACO 650T Mineral Cylinder Oil
	Spindle Guide Bearings and other miscellaneous bearings	TEXACO Nabob Oil
	Reduction Gearing	TEXACO Crater Compound No. 1
	Bevel Gearing (Open Lubrication)	TEXACO Crater Compound No. 1
	Bevel Gearing (Force Feed Lubrication)	TEXACO 650T Mineral Cyl Oil.
	Miscellaneous Mechanism including Ironing Roller, Pot Charging Equipment, and Overhead Cranes:	
	Gearing	TEXACO Crater Compound No. 1
	Bearings	TEXACO Nabob or Aleph Oil
Bottle Machinery:	**(Single Table) Vacuum Type:**	
	Force Feed Lubricating System	TEXACO Capella or Cetus Oil
	Step Bearings	TEXACO Capella or Cetus Oil
	Reduction Gearing and other gears	TEXACO Crater Compound No. 1
	Spindle Guide Bearings	TEXACO Sponge Grease
	Dual Table Type:	
	General Bearing Lubrication	TEXACO Nabob Oil
	General Gear Lubrication	TEXACO Crater Compound No. 1
Window Glass Machinery:	**Where Glass is Blown in Long Cylinders:**	
	Bearing Lubrication	TEXACO Nabob or Aleph Oil
	Reduction and Driving Gears	TEXACO Crater Compound No. 1
	Worm Gears	TEXACO Thuban Compound "B"
	Where Glass is Drawn Directly onto the Flattening Table:	
	Bearings of Drawing Machine and Rolls, etc	TEXACO 650T Mineral Cylinder Oil
	Worm and Bevel Gearing	TEXACO Thuban Compound "B"
	Miscellaneous Lubrication (When oil is desired)	TEXACO Nabob Oil or Aleph Oil
	When Comp. Grease Cups are installed	TEXACO Sponge Grease
Glass Pressing Machinery:	**Wide Mouth Bottle Press:**	
	Driving Gearing	TEXACO Thuban Compound "B"
	Force Feed Lubricating System	TEXACO Nabob or Aleph Oil
	Mould Table:	
	Ball Bearings	TEXACO Petrolatum or No. 00 Grease
	Air Cylinders, etc	TEXACO Capella Oil
Lehr Mechanism:	*General Gear, Pinion and Rack Lubrication*	TEXACO Crater Compound No. 1
	General Bearing Lubrication	TEXACO Nabob or Aleph Oil
Auxiliary Machinery:	**Mixing Equipment:**	
	Gearing (Film Lubrication)	TEXACO Crater Compound No. 1
	Gearing (Bath Lubrication)	TEXACO Thuban Compound "B"
	Bearings and other Mechanism	TEXACO Nabob or Aleph Oil
	Compressors:	
	Crank Case and Splash Oiling Systems	TEXACO Regal Oil
	Air Cylinders	TEXACO Cetus Oil
	Drip Oil Cups and Hand Oiling	TEXACO Aleph Oil
	Blowers:	
	Crank Case and Splash Oiling Systems	TEXACO Regal Oil
	Drip Oil Cups and Hand Oiling	TEXACO Aleph Oil
	Gas Producers:	
	Gear Lubrication	TEXACO Crater Compound No. 1 or No. 2
	Bearings:	
	Drip Oil Cups or Hand Oiling	TEXACO Nabob or Aleph Oil
	Compression Grease Cups	TEXACO Sponge Grease
	Steam Cylinders:	
	For Superheated Steam	TEXACO 650 T Cylinder Oil
	For Saturated Steam (above 150 pound pressure)	TEXACO Leader Cylinder Oil
	For Saturated Steam (below 150 pound pressure)	TEXACO Pinnacle Cylinder Oil
	For Wet Steam	TEXACO Summit Valve Oil

NOTE: In some instances, unusual operating conditions might require individual treatment. In that event tell us the name of the manufacturer, the type of machine, the general operating conditions, and we will advise you as to the right Texaco Lubricant for the best possible service.

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1—TEXACO Turbine Oils do not emulsify.
2—They do not break down with continued use.
3—They do not cause corrosion of shafts and bearings.
4—They do not hold water in suspension.
5—They are uniform. Barrel after barrel, bought any time or any place, will exhibit the same physical characteristics.
6—They are economical because due to negligible evaporation and absence of decomposition, only a very little additional oil is needed to make up the small natural losses.
7—They are obtainable instantly at any of our numerous stations and warehouses all over the country.

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Ring Oiler Bearings, *Normal conditions*	**TEXACO REGAL OIL**
Ring Oiler Bearings, *Exposed to high temperatures*	**TEXACO ALCAID OIL**
Circulating Oiling Systems, *Direct drive*	**TEXACO REGAL OIL**
Circulating Oiling Systems, *Reduction geared*	**TEXACO ALCAID OIL**

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